DISCUSSION* ON "THE LONDON TELEVISION SERVICE"† AND "THE MARCONI-E.M.I. TELEVISION SYSTEM"‡

MERSEY AND NORTH WALES (LIVERPOOL) CENTRE, AT LIVERPOOL, 28TH NOVEMBER, 1938

'rof. E. W. Marchant: I should like to say a word or) about the developments that have taken place which 'e enabled television transmission to come about. It ıot much more than 30 years since the cathode-ray illograph was first used in laboratories as a rather cialized scientific instrument, and those of us who ıember the difficulties of the experiments that were de in those days will appreciate the immense amount hard work and scientific investigation that has been ded to produce the apparatus that sends out and ɛives television to-day. At the University of Liver-)l we have made during the last few years a number :xperiments with short waves, and we know some of problems that are involved in their production.

)ne point of interest is that no less than five micro-)nes are used for a sound broadcast. This means that ɛn one is listening to a broadcast, say, of a concert, : is getting something that one cannot get if one ends the concert. The broadcast version is obtained m a number of microphones in specially arranged itions in the hall, and is therefore a better result than ıeard in the hall itself.

remember seeing the first transmissions that were t out from Alexandra Palace, in October, 1936. The tures were extraordinarily good, and no one could h to have pictures with better definition than we have day. The chief criticism that has been made by iewers " is that the size of the picture is too limited. do not think this criticism is justified. Considerable)rts have been made to produce large-scale television tures, but it seems to me that such pictures would be advance on what one already gets with the cinema.

The technique that has been developed in connection h television " productions " is one which is only just ginning. As time goes on, we shall realize the possi- ties of television far more than we do at present.

am very interested in Fig. 18 of the paper by Messrs. Macnamara and Birkinshaw, showing the range of transmission round London. Many years ago we found that with short waves transmitted over short distances the kind of thing that produces weakening of the signals is a comparatively small obstacle.

Has any television transmission been received at long range, say in South Africa?

Mr. E. J. Johnston: I should be glad if Messrs. Macnamara and Birkinshaw would confirm that in the case of the Marconi sound transmitter the master oscillator works at half the carrier frequency, and not at twice the carrier frequency as is stated on page 52. It is noticed that a stability of $\pm$ 1 part in 100 000 is claimed: does this refer to a time period of 24 hours? Is the idea of feeding the master-oscillator filament from a mains-driven rectifier to enable it to be continuously worked, so as to avoid frequency variation?

It would appear that neither the sound nor the vision transmitter is crystal-controlled. In view of the fact that it has been found possible to grind crystals down so as to resonate at frequencies as high as 60 Mc./sec. with a practically zero frequency-temperature coefficient, perhaps the authors will explain why such crystals are not used.

Mr. G. H. Rawcliffe: First, we are told that the maximum modulation frequency is 2·5 Mc./sec. On what basis was this chosen? In sound transmission the desirable modulation frequency has a definite upper limit, this being the frequency of the highest harmonics in the sound wave which are audible to the human ear. In vision transmission it seems to me that there is no such obvious upper limit due to the properties of the human eye, and that the brightness of the picture might vary in space at any rate whatsoever. Now a modulation frequency of 2·5 Mc./sec. and a line frequency of 10 125 lines per sec. give a maximum of about 250 modulations per line, and it is this value which I should like the authors to justify.

Secondly, I understand that the sensitized surface of the Emitron camera consists of a number of discrete particles

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Paper by Messrs. T. C. MACNAMARA and D. C. BIRKINSHAW (see *Proceedings e Wireless Section*, 1939, vol. 14, p. 36.
Paper by Messrs. A. D. BLUMLEIN, C. O. BROWNE, N. E. DAVIS, and E. EN (see *Proceedings of the Wireless Section*, 1939, vol. 14, p. 65.

and I should like to know, roughly, the particle density, and whether this causes any irregularity, or is in any way connected with the modulation frequency.

Lastly, Mr. Blumlein, in Section (4) of the paper, suggests that phase modulation was contemplated instead of amplitude modulation. What factor in vision transmission caused this reversal of sound-transmission practice to be considered, and why was it finally abandoned?

[The authors' replies to this discussion will be found on page 310.]

SOUTH MIDLAND CENTRE, AT BIRMINGHAM, 5TH DECEMBER, 1938

Dr. J. Greig: The points which I wish to raise are concerned primarily with the output stages of the transmitter.

It would be interesting to know whether the adoption of the conventional neutrodyne bridge for the final stage was determined by the fact that suitable water-cooled pentodes were not available commercially at the time the transmitter was designed.

Does the phase displacement for the extreme side frequencies shown by the half-ellipse in Fig. 22 of the paper by Messrs. Blumlein, Browne, Davis, and Green, represent a limiting value of phase-shift which can be tolerated, or is reduction in amplitude still the significant factor?

Two further points of general interest: would it be possible to mention the form of circuit in which the synchronizing pulses are added to the vision signal; and is any special technique, such as the use of a specially built "picture" tube, employed in the transmission of the present standard tuning pattern?

Mr. J. A. Cooper: Having had no personal experience of television or short-wave transmitters, I propose to limit my remarks almost exclusively to the paper by Messrs. Macnamara and Birkinshaw, and to confine them to less specialized matters.

On page 44 it is stated that, in effect, a television programme is produced before an audience. This being so, one might expect the parallel to a theatre footlights system.

On page 45 it is stated that high-angle lighting is supplemented by spot lamps at floor level. Fig. 7 indicates that these lamps are few in number. It would be interesting to know why the bulk of illumination is of the high-angle type when footlights and general frontal lighting might be expected to give a brighter image in the Emitron.

On the same page it is stated that experiments are to be carried out to determine the suitability of lamps of the water-cooled gaseous-discharge type. As the paper was written in 1937, these experiments have by now probably taken place, and it would be interesting to have an account of the results.

On page 48 it is stated that controls are introduced which take account of the finite time of transmission of the scanning wave-forms and vision signals along the camera cables. Some information regarding the design and operation of these controls would be of interest.

Mr. Blumlein refers in detail to line- and frame-synchronizing signals. Nothing is said in either of the papers to indicate how these signals affect the receiver. They obviously allow time for the flyback operations to take place, but, as the signals are so carefully arranged, I feel there must be some reason why such particular care is taken regarding the various impulses. Could some more information be given on this point?

Mr. S. T. Stevens: In the Emitron camera, by suitably altering the amplitude of the line- and frame-scanning pulses, it is possible to cut down the area of the picture which is being scanned on the mosaic in such a way that if the head and shoulders of a person were normally in the centre of a rather large area of screen the reduction in mosaic scanning would pick out the head and shoulders only of the subject. This would be the equivalent of tracking the Emitron camera forward, although there would be no actual movement. I should be interested to learn whether this practice is in use at Alexandra Palace.

I understand that in the Super-Emitron camera the primary electrons are projected in the optical plane down the tube from what is actually a photocell combination at the front of the tube, and are made to strike a mosaic which is normally photosensitized. It is understood that this mosaic need not be a true mosaic as in the case of the ordinary Emitron camera and that a plain mica plate may be used. Secondary electrons evidently have to be released from this plate to effect the amplification used in the Super-Emitron, and I should like to know how this comes about without there being any secondary-emissive material on the signal plate.

In connection with mechanical receivers, it was found that the original synchronizing pulses given out by the B.B.C. signals were not quite suitable for synchronizing mechanical scanners at the receiving end. I should like to know what changes were afterwards made in the transmitted envelope form of the synchronizing signals, to avoid this difficulty.

Mr. W. R. Bowler: It is understood that the cable used for outside broadcasts must have a very low attenuation factor. The apparatus used for testing the cable sections with a view to balancing these losses must therefore have a high degree of efficiency. Can any information be given as to the type of apparatus used for this purpose, and the degree of accuracy achieved?

Mr. A. E. Stollard: What is the greatest distance over which television has taken place, and what are the possibilities of the range being extended?

Mr. W. Hawking: I should like to know what is the field-strength value necessary for adequate reception of television, and whether this value is directly dependent on the maintenance of an optical path. Is the strength of the field the vital factor determining the limit for satisfactory transmission, or is the high interference/signal ratio that would be experienced at a distance from the transmitting station a more important consideration?

In the southern part of the area shown in Fig. 18 of the paper by Messrs. Macnamara and Birkinshaw we have two contours around Sanderstead and Sutton where high ground exists and where the field strength is approximately 1 to 1·25 μV per metre. I should have expected

that beyond the high ground on the remote side of the transmitting station the field strength would have fallen away very rapidly, but, on the contrary, it appears to be stronger here than at other points which are at the same radial distance from the transmitter and are less heavily screened.

With regard to the transmission of television by wire and cable, I should be glad of some information as to the difficulty which is being experienced in using the coaxial cable for the transmission of television programmes from London to, say, Birmingham. Is the major difficulty the difference in transmission time between the extreme frequencies necessary for the transmission of the television frequency band?

Mr. H. Joseph: I notice that the figures chosen for the number of lines are all a multiple of 3. For the experimental transmission the number of lines was 30, which is 3×10; in the next attempt the number was 180, which is $3^2 \times 20$; the next 243, which is 3^5; and the final one is 405, which is $3^4 \times 5$. Perhaps Messrs. Macnamara and Birkinshaw would give us the reason for this.

Mr. D. R. Parsons: I notice that in the experimental Baird transmitter used before the Marconi-E.M.I. apparatus was finally decided upon, the original radio frequency was about 1·4 Mc./sec.; and on the mobile transmitter and the Alexandra Palace transmitter now used by the B.B.C. the original operating frequencies used by the master oscillator are 32 Mc./sec. and 22·5 Mc./sec. respectively. This means only one stage of doubling followed by the radio-frequency amplification. It would be interesting to know why such high freqencies were chosen.

The authors do not mention what type of circuit is used in such exceptionally high-frequency master oscillators. For the portable transmitter a stability of 1 part in 5 000 is specified. This is rather a poor stability, but it may be quite satisfactory in view of the large bandwidth of the receivers used and the absence of any other transmitters on neighbouring frequencies.

I notice that the local sound and vision aerials cause a signal of 10 volts to be induced across the input terminals of the receiver used for picking up the signals from the mobile transmitter working on 64 Mc./sec. A filter is used to cut this voltage down by 70 db. Would the addition of a signal-frequency high-frequency stage simplify the design of the filter and also enable some of the more distant outside television broadcasts to be picked up more efficiently?

Mr. T. D. Wright: Messrs. Macnamara and Birkinshaw's pictures of the studio arrangements indicate that the lighting is flooded all over the setting. As the definition in television reproduction depends on the light and shade, would it not be more suitable for transmission and possibly give more definition in the received picture if the light were concentrated, so that the shadows showed up on the forms?

Mr. M. E. Tufnail: Messrs. Macnamara and Birkinshaw refer to the arrangement of lighting employed to produce an illusion of depth. Since the pictures are received on a flat surface, it is difficult to appreciate how the illusion of depth can be given.

The whole subject of television transmission appears to be complicated by the necessity for scanning and synchronization. It has been mentioned that the start of television comprised the invention of scanning, and I should like to ask whether any systems have been contemplated which would not involve scanning. I would point out in this connection that the great majority of early systems of telegraphy involved synchronization of the transmitter and receiver, but these have since been superseded by systems which do not necessitate synchronization.

Mr. C. R. Jephcott: In connection with the frequencies chosen for the sound and vision transmitters, namely 41·5 and 45 Mc./sec. respectively, it would be interesting to learn whether the separation of 3·5 Mc./sec. has been found sufficient in practice to prevent side-band interference completely between the two signals. Is the service area of the station likely to be affected to any appreciable extent for greater power output from the transmitters?

With regard to the mobile ultra-short-wave vision transmitter, will Messrs. Macnamara and Birkinshaw indicate the approximate useful range of this unit.

Lastly, what is the average expected life of a cathode-ray tube as used in a standard television receiver, employing, say, a 12-in. diameter tube giving a 10 in. × 8 in. picture; and what is the screen size adopted in the monitoring equipments used at the London Television Station?

Mr. P. E. Farren: Mr. Blumlein refers to the advantages obtained by interlaced scanning. Apparently only a double interlace is used, and I should like to know whether consideration has been given to triple or quadruple scanning, and whether such scanning would give improved results.

Mr. H. Faulkner: From the design details given in the paper by Messrs. Davis and Green it seems that the plan has been to take a particular valve and work at the maximum power output which can be obtained. This seems to be a reversal of the normal process of design, in which one would have expected a particular power output to have been decided upon and the valve transmitter to have been designed in such a way as to give this power output. It seems to become a question of the design of a suitable filament when given the required emission, which is not a very difficult problem. There may, however, be limitations in the practical design of this type of valve for use at these frequencies, and it would be interesting if the authors would indicate what are the present limits of development in this direction.

As regards the arrangements to ensure that the frequency of the frame is held in synchronism with that of the grid supply, I should be interested to know whether the hour-to-hour variations which must occur in the frequency of the grid supply are sufficient to cause any trouble. The number of cycles generated by grid stations is a fixed quantity over a particular period of time. This is made possible, it is understood, by a slight speeding-up or reduction in frequency from time to time.

The use of demountable-type screen-grid valves on the Baird system of television described in Messrs. Macnamara and Birkinshaw's paper is of interest. Valves of this type have also been used in the short-wave trans-

mitters of the Post Office, and were in fact developed by the Metropolitan-Vickers Electrical Co. for that purpose at the request of the Post Office. The feature of this kind of valve which allows more flexibility in electrode design, especially during experimental stages, is a very useful one, and screen-grids have obvious applications in short-wave work.

Mr. J. J. E. Aspin: I should like to know whether the authors have conducted experiments on the spacing of directors and reflectors in the case of television receiving aerials and the transmitting arrays used at Alexandra Palace, and, if so, whether the findings were in agreement with those of G. H. Brown,* who suggests spacings less than a quarter of a wavelength in the case of simple dipole aerials.

Mr. H. G. S. Peck: One cannot but be struck by the enormous amount of work which has been done in developing television in a comparatively short time. While television is an extension of sound radio-communication and telephony, it is a very great advance in every way upon what has already been done in these two branches of electrical engineering.

The Post Office has provided a system of special cables for outside television broadcasts connecting strategic points in London with Broadcasting House and Alexandra Palace; it is interesting to learn that it is possible to extend this by the use of a link consisting of ordinary telephone cable up to 2 miles in length if it is suitably equalized.

The authors say very little about the coaxial cable which has been laid between London, Birmingham, and Manchester. If television becomes at all popular, I can imagine that the Post Office engineers will be very busy in doing what they can to eliminate interference.

* *Proceedings of the Institute of Radio Engineers*, 1937, vol. 25, p. 78.